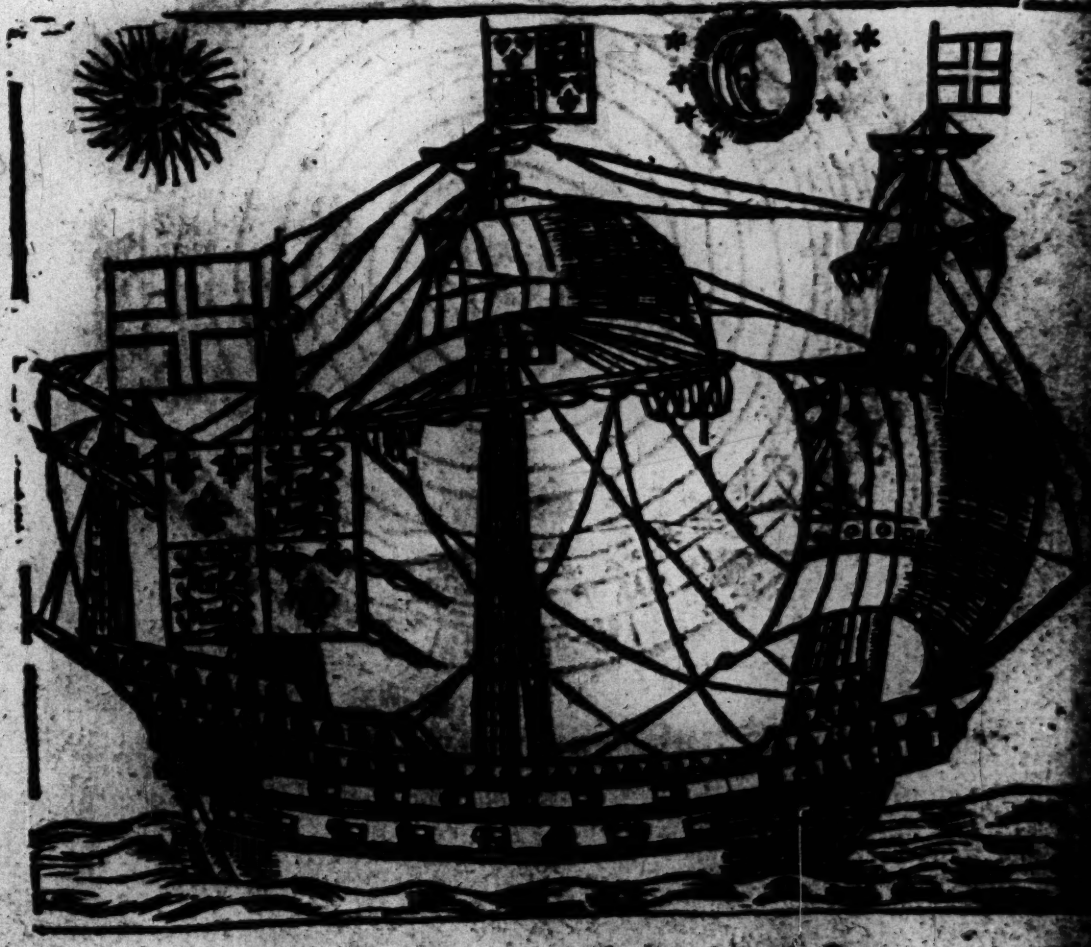
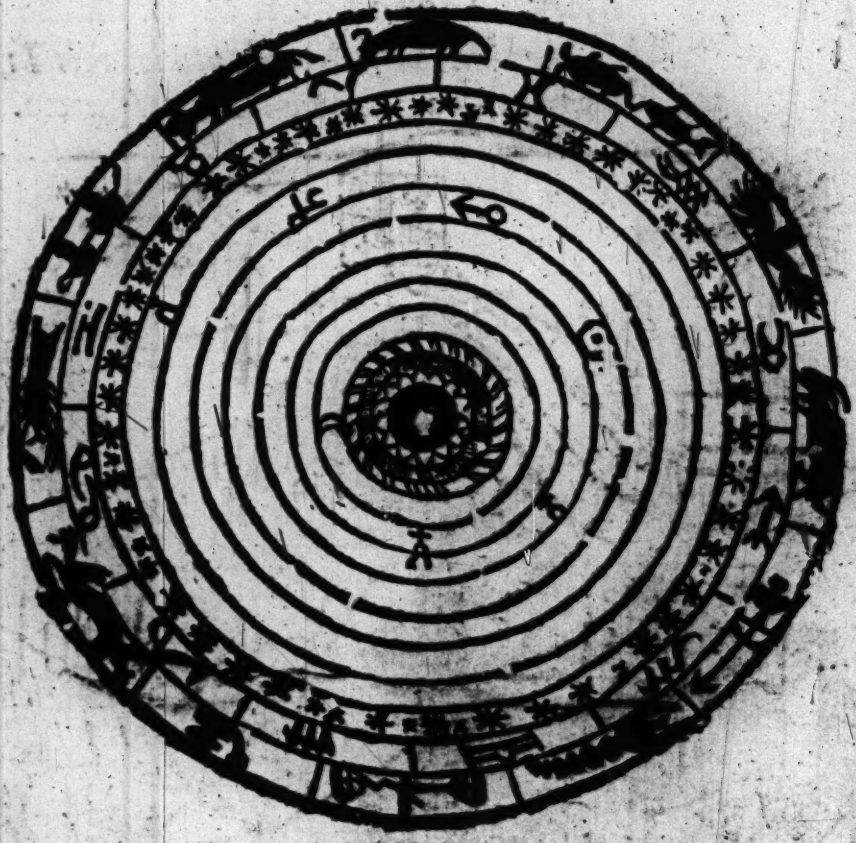
FRIEND TO NAVIGATIO

Plainely expreſsing to the capacity of the ſimpler ſo
the whole miſtery or foundation of the ſame Art, for
whoſe ſake, the Author hath onely penned this Trea-
tiſe, being himſelfe a faithfull good willer thereto.



Printed at *London*, by *T.C.* 1628.



TO ALL THE MOST NOBLE AND GENEROVS SEAMEN of *England*, happineſſe in *this life, and eternally in the* Heauens.

VRánia hauing brought mee (Right Noble) to the ſight of your moſt admirable Art, I could not chooſe but ſay, none could doe ſo great a worke, but the maker of all things. And ſeeing it framed of ſo many excellent peeces, to ſay; none but the Diuine prouidence can vphold it: Whereupon I endeauoured to inable my ſelfe in ſome knowledge thereof; and (though poore) I Purchaſed ſome bookes, and in diuers yeares beſtowed much mony; imploying my houres that I could

spare in this studie and practise. And in the meane time, much sickneſſe, and death of my friends, bringing mee vnder [redacted] intollerable bondage [redacted], made me come neerer this Honourable City; but with the loſſe of almoſt my whole eſtate: and in the way had both my Bookes and goods, all loſt and ſpoyled in the *Thames* water. Neuertheleſſe (although almoſt vtterly vnabled and [redacted] learned) I haue not ceaſed to do good if poſſible I might (knowing that no man is borne for himſelfe.) Therefore I ſet forth in a bill at my dore, to Teach the Art of *Nauigation*, to the poorer ſort *gratis*: And not ſo content I haue here framed a good order there of (as I think) to ſend abroad to thoſe that cannot come to me. May it pleaſe you therefore vnder your fauourable [redacted] direction, to admit it your preſence once onely: to aske you leaue, and to giue you account what I doe among your ſeruants as is moſt meete. And for your fauourable entertainement of it, your [redacted] reſpect to me for my good will, and your kinde acceptance, I reſt,

Your Honours ſeruant
to be commanded,

John Skay.

To the Ignorant and Honeſt Reader.

Oneſt Reader, this worke intended for thy good, diſpiſe not, but rather accept it thankefully, ſeeing if it were better I ſhould haue giuen it vnto thee; and more, while I liue I reſt all wayes ready to do thee what good I may. Thou haſt here ſixe Chapters: The firſt is of the Coſmographicall deſcription of the world: The ſecond is of the meaſure of the heauens: The third of the Elements: The fourth is of the ground of the Art, The Inſtrument, Aſtronomicall propoſitions, with the Geographicall [illegible], and Hydrographicall deſcription of the Earth and Sea: The firſt Chapter is of certaine conſiderations briefly ſet downe: The ſixt is of Shipping and going out of the Harbour: The ſeuenth

seuenth of the iournall obſeruation and proiection: The eight and ninth is of propoſitions of Nauigation Arithmetically, Geometrically, and Inſtrumentally ſhewed: The tenth is of the motion of the Moone, and of comming into the Harbour. If thou profit by it, giue God the glory, to whom be praiſe for euer, Amen. Vale, *From my houſe in Saint*
Thomas *Spittle, May the firſt,*
1628.

Iohn Skay.

A FRIEND OF NAVIGATION.

CHAP. I.

Of the Cosmographicall discription of the World.

THat which the onely wise God made for mans behoose, euen all the world of nothing, *Genesis* the first, is said to be round by all moderne Writers: it is proued by reason, and the holy Scripture saith it, *Psal.* 98. It was diuided in two parts by the same God, the part seene, and the part vnseene: But by faith search the Scriptures, there is the pure and vse in this our Christian Nauigation discouered.

The part seene is well defined to bee a Booke, In which wee may see and learne to praise God in his workes. And is said to bee of two parts, Celestiall, and Elementall: In the Celestiall part may be considered the Arts, as Musicke, the harmony of the Spheres: of Soule and Body, for whose health Phisicke is neuer, in which we consider that Miraculous Medicine of preseruing life, be it Philosopher stone, Salt, Virgin-earth, or other denomination, or Mathematicall, as the knowledge of Points, Lines, Circles, Signes, Constelations, Planets, and their Influence and power ouer bodies Elementall.

It may be said and that by good reason, I should begin at the Center of the Earth, & so consider of the things contained therein,

ing with the Sea, The face of the Earth and Sea, and the things thereon; The Aire couering the other two, and the Fire including them all, making one round body of these Elementall parts, being as a Center to the rest, and so passe vpwards vnto the first mouer, shewing the relation and agreement they haue together, I being now nearer the Center of the Earth (as it is obserued) by many thousand miles. But if I end my worke so high may bee proud (as some are) or dazelled in the Celestiall brightnesse, being mortall, be cast downe with *Phaeton*.

In the name of God therefore, and in his feare, I will begin with the first mouer, which going with great violence, turneth the whole frame of the heauen within it, round in 24. houres, from East to West: Which heauen is said to haue no impression in it, being almost invisible, yet carrying the light and darknesse, making difference of time in daies and nights, according to the difference of Longitude and Latitude of places on Earth.

In it are all the circles and poines in the whole fabricke of the world said to be described, their plaines descending and meeting in the Center of the Earth, or on their other Centers.

The two principall points, are the two poles of the world, the North pole elevated with vs heere at *London* 51. degrees, 30. or there about; and the South pole is right opposite to it. Therefore depressed inft as much (vnder the horizon of which I will speake anon.) These two points are fixed fast and vnmoueable, betweene which and through the Center of the Earth, there passeth a right line, which is called the Axe-tree of the world on which it turneth.

Now we must consider both this right line, and all other right lines, cords, figures, great circles and paralels, to be diuided into 360. degrees, each degree subdiuided into 60. minutes, each minute into 60. Seconds, each Second in 60. thirds, &c. as the case may require.

The Horizon is a great circle, whose Center is in the middest of the Earth, and his plaine reacheth not onely to the face of the Earth, diuiding the vpper part from the lower, the day from the night: But through the Orbes of the planets and fixed starres, euen to the first mouer. This circle hath two poles, one is called *Zenith*,

and

and is right ouer our head, from the which if a right line passe through the Center of the Earth, touching the concaue superficies of the first Mouer, it pointeth out the other Pole, called Nador. In this Circle we count the Amplitude of the Sunne or Starres, and the Point of the Compasse or Wind. All the Circles called Azimuthes, crosse the Horizon at Rectangles and passe through the Poles thereof. His Parallels are Circles of Altitude, in which are obserued the position of the Planets and fixed Starres aboue the Earth, at all houres of the day or night: Or Circles of Depression dividing the length of twilight.

The Equator is a great Circle, deuiding the World into two equall parts, the North part and the South: His parallels sets out the Latitude of places on Earth, and declination in the Heauens. All the Meridians doe crosse the Equator at Rectangles, and go through the Poles of the World. On this is counted the Longitude of places on the Earth or Sea: For euerie 4 of equall time made by the equall motion of the Equator doth make 1 degree. And 7 deg. 30 min. of Longitude, either East or West doth cause 1 houre difference in time of day or night, and they that dwell 15, or 30 deg. East haue it 12 or 11 a clocke, when we haue it 10 or 11, and those that dwell so much West of vs, haue it 10 or 11 when it is midnight with vs. Those that dwell at the East part of our Horizon haue it noone when it is but 6 in the morning with vs, and when it is noone with vs, it is 6 at night with them, but with them in the West part of our Horizon it is 6 in the morning. Our Antipodes haue it noone when it is midnight with vs, and when it is Summer with vs, it is Winter with them.

All other Circles not yet named are likewise supposed to bee in the first Heauen, as in the rest of the inferior Orbes, of which we suppose 11 after *Ptolomie*. And no good reason for the Lord of Heauen and Earth hath so layed the foundations of the Earth that they cannot be moued, *Psal.* 104. 5. Though God suffer to bring some good purpose about hath imagined so.

Let the tenth Heauen be (if you please) the Waters aboue the Firmament, for there are so, *Gen.* 1. 8, 7.

CHAP. II.

Of the measure of the heauens.

The Zodiaque is a great broad circle croſſing the heauens, like a girdle or girdle, of 12. broad at the leaſt, in the midſt whereof is a little circle called the ecliptique line, which croſſeth the Equator at two oppoſit poincts, wandring from it 23. 30. at the leaſt as I haue found by obſeruation this preſent yeare 1617. ſo the poles of the Ecliptique are diſtant from the poles of the world 23. 30. by reaſon of his obliquitie: betweene which poles there paſſeth a right line or Axetree on which the ſecond mouer or ninth heauē is carried in his owne motion (contrary to the firſt) from Weſt to Eaſt, and is moſt ſlowe, making his reuolution in 3434 yeares, and 10. daies.

The third mouer or ninth heauen, hath his two poles in the two poincts of the equator and ecliptique, and his motion is from North to South: making his reuolution in 7717. yeares and 5 daies. But it will be ſufficient for our neceſſary vſe here to obſerue the motion of the 8. Sphere, wherein are all the Celeſtiall bodies of the fixed Starres placed: whoſe motion is from Weſt to Eaſt, (ſome ſay but one degree in 100. yeare. But the Planets mone in their Orbes ♄ in 30 yeare, ♃ Iupiter in 12. yeares, ♂ Mars in 2. yeares, ☉ Sol in one yeare, ♀ Venus and ☿ Mercury like ☉, Luna ☾ in a month from Weſt to Eaſt.

Diuers learned Mathematicians haue ſet downe the magnitude of the Starres to be farre bigger then the earth: making 6. differences in bignes, beſides duske and obſcure. The Planets alſo [illegible] of diuers bignesses and diſtances. The Orbe of ♄ is [illegible] miles, and his diſtance from ♃ 78721 [illegible] The Orbe of ♃ [illegible] m. His diſtance to ♂ 78721. m. The Orbe of ♂ [illegible] m. his diſtance from ☉ 15725. m. ☉ 34299[illegible] m. His diſtance from ♀ 23437½ m. The Orbe of ♀ 3274494½. Her diſtance from ☿ 12812. m. ☿ Orbe 2533721½. m. His difference from ☾ 11812. The ☾ to be in bignes 105222 m. her diſtance from the earth 15750. m. ♄ his bigneſſe compared to the Earth is as 95. to 1. and his diſtance to the Firmament

120449.

119445. m. Of his latitude on the Earth is 29 [illegible] 91. 124. And of 152. to. m. And the distant from the Firmament on the Earth 95 846 3/4 m.

It hath appeared manifestly that both by Sea and Land a man so trauaileth 60. miles on a great Circle, alereth a degree in his Trauaile: which taken 360 times the number of the whole circle, maketh 21600 miles the compasse of the whole Earth and Sea. The Diameter then will be 6875 1/11. the semy diameter 3436 4/11 m. which maketh the firmament to be from the Center of the Earth 36189941/2. Therefore it seemeth there is something to worke vpon to measure these things by.

Likewise I may say, considering that from the earth to the Moone is 15750. miles, and the ☾ is the lowest Planet. Therefore the two vppermost elements of Ayre and Fire are both together 15750 mi. in thicknesse: Againe, because the hill Atlas is said to reach to the midle region of the ayre, that hill (which I take to be Teneriffe) may easily be measured, and so the measure of all the rest is had.

The motion of the Ecliptick causeth other foure circles to be described, two are described by the motion of the Poles thereof, being distant from the poles of the world 23. degrees 30. min. making two round circles about them: that next the North pole is called the circle Articke, the other is called the circle Antarticke. The other two are described by the motion of the tow Tropicall points of the ecliptick, that on the North side of the equanox is called the tropicke of Cancer, the other is called the tropicke of Capricorne. The Zodiacke is diuided in 12. equall parts, beginning at the one intersection of the same with the equanoctiall circle, and so going round: And these are called the 12. signes of the Zodiacke, for as much as they extend them to the full breadth of the Zodiacke, and are the cause thereof.

There are two other circles also of speciall vse in this Art, one is the Equinoctiall colure, the other is the Solsticiall colure: These two are great circles, the first parteth the Equator and Zodiacke euen, so as the North signes are from the South signes parted by the first point of the first signe, and the first point of

the fourth signe: and these signes are called Aries ♈, and Libra ♎, beginning the Spring and Autumne, the other passeth by the two tropicall points of Cancer ♋, and Capricorne ♑, making the beginning of Summer and winter; both passing through the poles of the world, parting the Zodiacke in foure equall parts, and the equator also with all his paralels.

The first point of ♈, beginneth the Spring: that is, when the Sunne in his motion commeth first to that point, and going through three signes ♈, Taurus ♉, Gemini ♊: then comming to the first point of ♋, beginneth the Summer: and passing through other three signes ♋ Leo ♌, Virgo ♍, so commeth to Libra ♎, Scorpio ♏, Sagitarius ♐, to the first point of ♑: beginneth the winter, from thence through ♑, Aquarius ♒, Pisses ♓ making the whole yeares revolution. And these 12. signes are called Constellations, and there are other Constellations, some North, some South, in which is had a number of Starres bearing names, according to their nature: and these constellations beare rule ouer diuers Regions, Countries and Cities.

Now we may passe the Orbes of the other superiour Planets, & onely note their friendly aspect as we passe by them: And consider the ☾ motion with the ☉ for the Eclipses of vse, for finding of longitude on earth or Sea. Her monthly motion, full change and quarters, for the ebbing and flowing of the waters, spring and nepe tides: her aspect with the planets, good or euill, for Physicke. Her place in the Zodiacke, for bloud letting either for Man or Beast.

CHAP. III.

Of the Elements.

FIre is the most noble and superiour of all the Elements, pure, subtle, most spirituall, putting heat into all substances, lightsome, hauing motion Lionous, cholericke. Ayre is diuided into three Regions, that next the Fire is most hot, that in the middle most cold, vnto the which some hill tops doe clime, as hath been seene, the lowest is that in which wee liue, the Clouds and the

Fowles

Fowles doe flye, which God of his mercy make wholesome vnto vs. *God said let the waters vnder heauen be gathered into one place, and let the dry land appeare, Gen. 1. 9. And God called the dry land Earth, and the gathering together of the waters, he* (euen God) *called Sea, ver. 10.* Sea, which together with the earth make one huge massiue body, round, as may be proued by the artificiall Globe, ; but most truely by a perfect Artsman, who vsing his skill in his Trauell, both by Sea and Land, is able to salue such small irrigularities, as high tydes, lowe ebbes, high Mountaines, lowe Vallies: For experience is the mother of Arts, and thereof I partly conceiue in this (I hauing a brother in Saint *Christo-phers* Ile of the West *Indies*, who hath sent me Letters from *Mariues* Hope there) I went to *Gresham* Colledge in *London* of purpose to looke on the biggest Terrestriall Globe they had, and found such an Ile to lye in some 16. deg. of North Latitude, and in 321. deg. of longitude, or there about: But there I could finde neither Cape, nor Bay, Port nor Hauen; therefore no vniuersall Map will serue that turne: And Master [illegible], being there with mee at that time, made a doubt, saying: How know I that Saint *Christophers* Ile lyeth there except I had seene it, or know some body that had bin there? meaning no doubt some Arts-man, who (I confesse) may not onely obserue the longitude and latitude; but may also set out the Capes and Bayes, Ports, Bounds, Riuers, and giue the dimention of the superficis.

Of the innumerable multitude of creatures in the Sea, and of her riches, I will not speake; but the artificiall making and vse of Shipping therein is admirable, as may appeare in the whole Art of Nauigation: A wonderfull secret thereof is the variation of the compasse; a cause thereof is imagined to be the hollownesse of the Earth or depth of the Sea, and for that nature abhorring emptinesse, the excellent vertue of the Load-stone doth alwayes draw towards it in all places, where the needle being touched therewith shall draw most neere; but I thinke it is a speciall gift of God, sent for mans vse, but farre aboue his knowledge. Sea and earth are diuided as the heauens: the beginning of the Equator or first Meridian being with Saint *Michael* and Saint *Maries* Iles, the circle of the equator passing by

Saint *Thomas* Ile, *Abassance*, the famous Ile of *Sumatra*, *Borneo*, *Papoes*, *New Guinny*, *Guilans*, and so round, from Meridian to Meridian Eastward we count Longitude onely parallell: but Latitude is counted from the Equator towards the Poles of the World on the Meridian or colure. The Paralels sets our the Zones and Climates.

Of creatures without life, or such as are in the earth onely, are Gold, Siluer, precious Stones, Minerals, Mettals. But the Bodies which shall one day rise againe, are chiefely to be considered. Of Creatures with life, some are fixed, as Plants, Hearbes, Flowers, Spices, Trees, bearing fruit, without fruit. *Gen.* 2. 19. *Out of the ground God formed beasts and fowles*: and in another place it is said, *All flesh is grasse*. Therefore of moouing things some are in the Earth, as Wormes, Serpents, Moles, Conies; some in the Ayre, as Fowles: in the Water, as Fishes. Monsters on the face of the earth, as all manner of Beasts and Cattell wilde and tame. The most excellent thing made is man (a shame for him to become so wicked) *Being wonderfully made*, *Psal.* 139. an epitomy of the whole World; to seeke and set forth Gods glory: surely flesh and bloud cannot set forth his glory, whose workes doe amaze the sences of the most learned: Therefore be not proud O ye learned, nor vaineglorious O ye wise; but seeke and set forth Gods glory, that the vnwise and vnlearned, may see, marke, and learne: and be incouraged O thou that art ignorant (of which I am chiefe) to see the workes of the Lord in heauen and in earth, and his wonders in the deepe Sea, *Ps.* 107.

CAHP. IIII.

The ground of the Art, the Instrument, Astronomycall propositions, with the Geographicall and Hidrographicall description of the Earth and Sea.

REason doth teach, and this 36. yeares experience I haue had, that to the gaining of these knowledges, quantitie is to be considered, either Geometrically or Arithmetically, or most vsually of both together. Arithmeticke is the Art of numbering, and

euery number is expreſſed by certaine Characters, figures, and Ciphers, as : 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. or : 2ª. 3ª. 30. 50. 2ª : ☌ + ☽ + 20 — 10 ♃ — n. But the figures and Ciphers whether they be abſtract or contract, haue a double ſignification to expreſſe them, which is called their numeration, Pſal. 90. ver. 12. *O Lord, teach vs ſo to number our daies, that we may apply our hearts vnto wiſdome.* Figures do either ſignifie themſelues onely, as 1. is one, 2. is two, &c. or are valued according to their place: Poſition of this kinde is knowne as men read the Hebrew tongue. This Art giueth the numerall ſolution in all dementions, and hath theſe kindes : Addition, Subtraction, Multiplication, Diuiſion; and theſe all haue a diuers property in their vſe, either in working proportion, or otherwiſe. Another Arithmatique there is (not of numbers) but of parts of number, hauing like ſpecies, properties and paſsions, and feteh either their beginning from vnity, but with a difference, for as number increaſeth in multitude Infinitly : ſo doe Fractions decreaſeth infinitly but moſt commonly, as in this worke, they are compound : for if I take in account of Time, Motion, Meaſure, Signes, Degrees, Minuts, Seconds, &c. As in reckoning of the ☾ place, Thus : ſuppoſe the ☾ in the day of ☌ to be in the fifth degree of ♈, and at 20. daies old, I would know her place; ſay if the ☾ go in one day 12. degrees from the ☉, and the ☉ goe each day one degree, Therefore the ☾ goes in 20. dayes 240ª. which diuided by 30ª. giueth 8° : 20ª. where 8. is the number 20, the Fraction, and his place the 20ª. of Sagitarius: But where deg. are taken for numbers, there Minuts, Seconds, Thirds, are Fractions : as 15ª. to an houre 4. to a degree, or 20ª. is as much as one houre 20 : or 20ª. 50. 30. is as much as 1250 miles ½: and generally all circles and paralels, are numbered with theſe kinde of Aſtronomicall Fractions or numbers.

Geometry giueth a punctuall termination to all dementions, either in length, breadth, or thickneſſe : which number many times cannot doe; as in diuiding a line by extreame and meane proportion. But number and parts do helpe Geometry to expreſſe the quantitie, bee it in length, breadth, or thickneſſe. Linemeaſurall as angles right lined, or Spherical: & may ſerue to meaſure ſome diſtance

in

Instruments necessary in any worke, are of necessity, and to this worke which conteineth so many Arts, it may be obiected that one poore though of a good capasity shall be neuer able to attaine. Say not so man, for the best instrument in any worke is a willing minde: Againe, shall I be ashamed to indeuour to doe well, because some more learned then I, will despise my simplicity and weakenesse in knowledge? No sure, the vertuous will commend it, God bee thanked there are as many good Instruments as Arts, let euery man bee content with such as hee hath, and God no doubt will blesse the good indeauours of the godly honest. 2s. 6d. on a paire of Compasses, and two pence on a straight ruler is not much: with these thou maiest beginne in spending some spare houres time to worke thus: first make a circle, diuid it in 360. parts, or ¼ into 90, and besides abundance of necessary conclusions, which the malicious ignorant will not beleeue, these following are not the least, and are most meet to be knowne: Radius or any signe, cord, arke, Tangent, Secant, great circle, parralell: example: I did take the ☉ height, *May* the 26. 1627. and so found his declination 22d. 30. North, his place being in 15d ♊. right assention 61d. 30. difference assentionall 28d. 15. height of the North pole 51d. 30. Amplitude 37d. 30 North. oblique assention 33d. 15.: semydiurnall arke 118d. 15. semynocturnall arke 61d. 45. his course from rising to his setting, 15 houres 40. length of twilight 8 houres 14. length of the night darke 0. houre. Likewise about December the 12. 1627. ☉ place 0 ♑ merid height 15d. declination 23d. 30. South, amplitude 40d. 30. south, right assention 270d. oblique assencion 298. deg. 30, difference assencional 28. d. 30. Likewise may the fourth 1629. suppose the sonnes place which is his longitude, found by the rules before going to be 53. d. or the 23. of ♉. in the latitude of 51. deg. 30. min. his merid. height is found by these rules to be 55. deg. declination 18. deg. north, amplitude 28. north, right assention 50. deg. oblique 27, deg. difference assentionall 23. deg. semydiurnall arke 7. hou. 32. min. semynocturnall arke 4. hou. 28. min. length of twilight 2. hou. 4. min. from noone to euening shut in 9. hou. 33. min. length of the day 19. hou. 6. min. night darke 4. hou. 54. min. Son rise at 4. hou. 28. m.

setteth

setteth at 7 hou. and 32 mint. Sup above the Horizon 15 hours 4 min. under the Horizon 8 hou. 56 min.

And here remember, that *The workes of the Lord are great, sought out of all them that have pleasure therein, Psal.* 111. 2. *His mercifull and gracious Lord hath so done his marvellous workes, that they ought to be had in remembrance, v.* 4. *The Lord is high above the Heavens, Psal.* 113. 4. *Who is like the Lord our God, that hath his dwelling so high, and yet humbleth himself to behold the things that are in Heaven and in Earth, v.* 5. *He taketh the simple out of the dust, v.* 6. *The Heavens declare the glorie of God, and the Firmament sheweth his handiworke, Psal.* 19. 1. As *Arcturus Orion* pleades the hiden Chambers of the South, the great *Leviathan* that moveth in the water, but beyond all, our Redemption in Christ, God commanded *Noah* to build an Arke, and to build Shiping were but vaine except God blesse it and bee the Sea-mans guide. Say then, is it not a great blessing we receive from him in guiding our Ships and Selues both by Sea and Land with such excellent Rules of Art: Surely the learned in the Geographicall, Hidrographicall and Nauticall Sciences must needs confesse it, especially those that travell.

Neither need any be so sottish as to thinke it a shame to spend ten min. of his idle time euerie day to some such good purpose, which may add him more comfort perhaps in distresse, then all the friends in the world besides. By the Scale made on a straight Ruler and Compasses distance is had easily without mentioning to them, for make a Circle and diuide it in foure equall parts with straight lines ouer the Centor, then diuide 3 in two equall parts, and ech of them in 3 then againe these subdiuisions in 3 and lastly those into 5, so is one quarter of the Circle diuided into 90 deg. by the same reason you may diuide a right line as your Ruler into Foots, ech Foot into Inches or Tenthe, ech 10 into 12. 3. 4. 5. 7. 11. 12. 16. 20 parts or what you please; and then begin to worke thus, Imagin to stand on Seams Hill at 12 High-gate, from thence to all the highest Hilles round about you cast your eye, and by your Circle diuided you may take the quantitie of the Angle from your eye to the two next Hilles from you and nereest one to another. Suppose that Shutors Hill and Purfleet

Hill doe make an Angle of ¼ of the quadrant or 30 deg. Or Harrow Hill and Saint Albones make an Angle of 40 deg. and the distance between High-gate and Shuters Hill to be 10 mil. more or lesse, and from High-gate to Harrow 12 mil. you shall goe to Shuters Hill and obserue the Angle between High-gate and Purfleet, be it right or oblique, acut or obtuse make 2 lines, whereof one to be laid downe by the Scale on your Ruler of the iust distance between your 2 first stations, at the one end make the first Angle, at the other end make the other looking one towards the other, and the two lines continued will point you out Purfleet, doe so by the other and it will point you out Saint Albones, then by your Scale you may know their distance, hauing them distances you may easily find all the distances and angles of position or situation of all the Hilles, Townes, Riuers, Borders, in any one Countie, and from thence ye may doe the like by the rest, and so take a true surueigh of a Kingdome, and of all the Iles, & Rockes in the Sea, and Kingdomes adioyning, as Scotland with his Iles, and ouer the Sea, as Ireland with his Iles, likewise from Doner to Callice, and so take the Countrey and Kingdome of France, with his Riuers, Iles, Rockes, and euerie remarkeable thing that commeth in view of your eye.

But note, that if you measure such great distances, you must haue regard to Longitude and Latitude, for if you shall measure from France to Spaine, Portugale, and so ouer the mouth of the Straits of Gubraltar into Barbarie, Guiny, by the Coast of Saint Thomas Ile, Monomotapa, Cape Good-hope, the Coast of Saint Laurence, Mosambique, Prester Iohn, the head of the ancient Riuer Nilus, the Arabian, Indean, Notalia, Grecian, Italian Countreys, so come to Germany, Polonia, and all those North parts to the Pole if you can, or to Sweden, Moscouia, and the North part of Tartaria, and thereby discouer all the North parts round about the Pole, and so if you can come into North America, if not, then coast ouer land neere the Caspian Sea, Parthia, Persia, Ormuse, Gulfe of Ses, Cochin, and all the Iles to the South thereof, the Gulph of Bengala, Malaca, Sumatra, the Strait of Sunda, Iaua maior, Iaua minor, new Ginny, Papoos, Hiland, Timor, so to Iapon, and to the discouerie of the parts of Malator Kingdome

to the South Pole if you will, or by the Molucco's, Borneo, Cambaia, Cochin China, Iapan China, or Cathay, from thence East a little North to the Straits of Anian, and so into the most Westerly parts of North America, Portray all that new world, to be short, come by the Gulph of Mexico down to the Strait of Land called Nova Hispaniola to Peru, goe ouer the Strait of Magilanica and discouer all the vnknowne Land round about the South Pole.

Which thing may be done by Gods permission no doubt, and when thou hast done this most truly, with all the Coasts of the Seas, thou wilt say the circompherence of the Sea is also had: True, yet neuertheless ye shall neuer be able to lay the true scenetry of both Earth and Sea on a plaine superficies by this way.

The like may you proue by the Hidrographicall discription of the Sea, by the common Sea Card. And here note, that this may serue likewise to proue that the Earth and Sea make one rounde Body.

CHAP. V.

Of certaine considerations to be remembred, briefly set downe.

AS I conceiue, there are these three things to be considered, without which sayling cannot be performed. The first, is an exact obseruation of the Sunne, Moone, and Starres. The second, is the perfect finding out of the variation of the Compasse. Lastly, a true reckoning of the Shipe way. These all doe helpe one another, and should be precisely had. Againe, the Earth and Sea making one round Body, we may consider that no sayle between 2 places, may be either by a Parabolly, a Rumbe or a great Circle, as ye may perceiue by the artificiall Globes. Therefore if ye can draw some blanke Charts to carrie with you in your voyages, such whose Meridians and Parralels beare such proportion one to the other in ech Latitude, as those in the Globe, you shall doe well.

In the Globe you may perceiue the degrees in the Equator to agree and be equall with the degrees in the Meridian. Now the

degrees in that Meridian are euerie where equal, but the degrees in the Parralels to the Equator are leſſe and leſſe, ſo that a degree of Longitude in the 60 deg. of Latitude is but ½ of that degree of Longitude in the Equator, and as the whole ſigne is to the number of parts in a degree of Longitude at the Equator, ſo is the ſigne of the complement of any Latitude to a fourth number (by the rule of proportion of geometricall demonſtration) which number tels you how many parts of a degree of the Equator ſemeth a degree of Longitude in that Latitude, but in a plaine Card where the Meridians are all Parraleis, there becauſe the degrees of Longitude in each Latitude are equall, you muſt increaſe the degrees of the Meridian in each Latitude in ſuch proportion as is aboue ſaid, which is eaſie to be done with the Scale on your Ruler.

This to looke on to the eye will be ſtrange, and to ſuch as loue their olde errors, in the plaine Card they will thinke it cleane againſt reaſon, but let ſuch deſcribe ſome portion of the world in it, they may compare it with a Globe, and ſee it beare a true ſemetry, but in their plaine Card it will appeare monſtrous. Here is now a view of the world from Centor to Circomference, Heroin I cut ſhort to the manner of obtaining to ſome abilitie in the vſe and practiſe thereof: But aboue all and in all things giue vnto the Lord the glorie due vnto his name, *Pſ.* 29. 1. And this indeed is the onely thing wherein we ought to reioyce, and for which God made vs, namely, to ſeeke his glorie, which is wonderfully ſeene and ſet forth in the frame of the World, but moſt brightly in the perſon of Chriſt but by Faith, with which eye then muſt we looke into Heauen by viewing here on Earth Gods holy Word, and hearkening with the eare of Faith, to the Miniſters of his Word, whoſoe breake the Bread of Life vnto the faithfull, and are able to giue ſtrong meat vnto ſtrong, & milke vnto babes, ſo fitting them to be the better able to worſhip the Lord in the beautie of his holineſſe, *Pſ.* 29. 2.

It appeareth, Gen. 1. 14. that God made the Lights in the Firmament to diuide the day from the night, and to be for ſignes and ſeaſons, dayes and yeeres. And v. 15. to giue light vpon the Earth, according to the roundneſſe of the Earth, and motion of

the

the ☉ the light and darkenesse doe differ, for the Sunnes body being bigger then the body of the Earth, maketh that the Sunne being at the Equator, although from Sunne rising to Sunne setting be iust 12 howres, yet the light will appeare from breake of day to euening shut in 14 h. 24 m. and the darkenesse will continue 9 h. 36 m. Now if two men be one vnder the North Pole, another vnder the South Pole, they shall both see the Sunne in their Horizon, if the ☉ decline towards the North, he will rise about the Horizon to him in the North, but to him in the South the ☉ setteth and when the ☉ is in the tropick of ♋ it is noone with him in the North, but with him in the South it is midnight (*& contrà.*) By this it appeareth the time betweene Sunne rising and Sunne set to either of them is about 4368 houres, ergo, seeing that the Lords louing kindnesse hath been of old, *Psal.* 25. 6 to this Christian part of the World, in placing the Suns Apoge in this part, by which we receiue a double benefit, the one of light so much the longer by the Sunnes slow motion, the other, that when the Sun is come so neere our Zeneth, it hath pleased God to draw it vp neerer Heauen and further from the Earth, that we be not burned with his heat, as it is written, The Sunne shall not burne thee by day, nor the Moone by night, *Ps.* 121. 6. *&c. contra.* in the South part of the World among the Heathen that know not God. But in the Poles the twilight lasteth so long as the Sun is within 18 deg. of the Horizon, which is about the first of May, so the darke night lasteth 1968 h. and the twilight is about 1200 h. that is 50 dayes with vs. From these two differences in a right Spheare you may make to your selfe a Theoricke of the oblique by considering the difference of light betweene any number of degrees from the Equator to the Poles as you please, or after this example: I did obserue the height of the Sunne this yeere 1627, and found him to be more then 62 deg. in Meridian height, proues that the Sun hath more then 23 deg. 30 min. declination, or else the Poles elevation to be lesse then 51 d. 30 m. here at London, which the learned haue likewise proued in their most exact obseruations, but for the lesse learned and the honest Sea-mans vse, the declination of 23 d. 30 m. will make no error. Note that in a Country of knowne Latitude you may finde

the height of the Sun his Azimuth and declination in any Longitude, by which you may find the variation of your Compasse at all houres of the day, or by the day of the month the Suns Meridian height being given, is had the Latitude of the place, or height of the Pole, then the amplitude or azimuth as before, and to speake truly, these propositions depend on one another, and what is said of the Sun, may likewise be done by the Stars being knowne, their Longitude, Latitude, and Declination being likewise had.

If any man shall say, I haue discouered my wants herein, he saith truly, if any malice my good will, let him know I care not, if any man will further my willing mind, to him I will send this Booke for Patronage, and for euer pray for him, if any sneare and scoffe at me, it were much better for his Soule that he were at prayers, and leaue scoffing. Euerie good man may if please him, amend this, and so further me. If no ignorant man will profit by it, yet let such as are honestly minded, suffer this to liue with me, because all that I haue, or can doe, is but to imploy my time in such meane knowledge as I haue, to Gods glorie, and the benefit of my Country. Wherein if knowledge and a purse did agree with heart and good will, I would striue with the best Subiect, In the meane time I will striue to doe my best, as my dutie doth bind me.

CHAP. VI.

Of Shipping and going out of the Harbor.

THese things afore spoken of, are most vsefull, and now I hold it a good method to examine your Ship whether shee be for your turne or not, in all things well appointed for the Sea, if new, how well built, and strong, and how well fitted in her stuffe, if old, whether she be able to indure the surging waues of the Sea, to goe another voyage, and likewise for her burthen, proportioned according to the businesse ye vse her for. But if ye will build a new Ship in any proportion assigned, ye shall iudge the better how to bring it done, by learning so much in Arithmeticke,

ticke, as to be able to extract the Square and Cube root, then may you doe after this example next following, or otherwise at your pleasure. Let the proportion be as two to one, and suppose you haue a Ship of 100 tun, in all things so well framed, that then doest desire to haue one of 200 tun, and like to the other, to do this, first take the measures of your first Ship, which suppose to be these, the Keele 44 foot, at the Beame 20 foot, in Houle 9 foot, her Rake afore 13 foot, after 7 foot, here is giuen sixe numbers, and the proportion assigned, and seeing the proportion is to be doubled, therfore take each number & cube it, then double that cube number, and extract the cube root of that number, and you shall find the second Ship must haue in Keele 55½ foot neere, and Beame 25 and about ½, in Houle 11½, Rake afore 16½, after almost 9, and her burthen will be 200 tun, or this may be found by that excellent Instrument of the memorable Mast. *Edmund Gunter*, lately set forth by him in his life-time, and is called a Sector, his proportionall Ruler and Cross-Staffe is well knowne to be an excellent Instrument for these purposes following, and also for many other, Take in equall parts of the Sector 44, and fit it ouer in the Cubes at 44, the Sector so resting, take with your Compasses the distance ouer in 88 of the Cubes, and apply it to the equall parts, giueth 55½, as before, do so by the rest, and you shall find the like numbers.

But say it be demanded to haue her of any other proportion, namely, as 20 to 15, or 4 to 3, take the measures of the first, as before, and cube them, then say, if 25 giue such a Cube, what Cube shall 20 giue, it will giue a number, whose Cube root is the number sought. But by the Sector take the numbers 25, 20, &c. in equall parts, and fit them ouer in 15 of the Cubes, then take the distance ouer in 20 of the same lines, and that applyed to the equall parts, giueth the number sought.

And now being furnished with a Ship for thy purpose, and hauing launched, and going downe the Riuer take heed to the set of the Tyde, not onely for running fowle of other craft, but least ye bring your selfe on ground on a Lee shore, on a Shelfe, Sand, or Shoot, as Barking shelfe, a Shole against Grayes, Blacke shelfe, the Piles below Tilberie, Milton shore, or in a darke night gape

for

for a shore, and thinke to gaine the point, but run your Ship cleane out of the Thames, as I see one had done, the 18 Decemb. 1617. and layd her on the March below Greene-hithe in Kent. Going out or in any River whatsoeuer, note what marke yee see with the opening of any Point, as Yoke on a Wall, Tree, House, Hill, Wood, Wind-mill, Steeple, Castle, or Towne, and learne to describe the Semetry of it, and note it in a Booke, remembring to sound the depth, and note it likewise, and what grounds for anchoring good or bad, with the swiftnesse and indraft or outlet of the waters, ye may also describe the windings thereof by the Compasse, with the lenghts and breadths on a Paper, and be sure to note the magnificall Azimuth, for your variations, be it of the Sunne or Starres, which to be able to do, learne so much in Geometry, as to be able to describe the Spheare in plaine, and to know the vse of the Globes, or at least to vse your plaine Scale, and keep your tranice on your Card, & a Iournall or daies Booke, and know both in River and at Sea, thou must make vse of these two Globes, namely, the Scriptures, where the good shine like Starres, and Christ Iesus is the true Load-stone.

CAHP. VII.

Of the Iournall, observation, and priviledge.

WHen you are come into the Sea, begin your Iournall in this wise: In the Name of God, Amen. The daies Booke for the Voyage intended, for Saint Christophers, and Caribe de Mine. The 24 of May wee came out of Portsmouth, and moored in Stokes Bay. The 25 wee weighed, and with a faire Easterly. The 26 we put thorough the Needles. The 27 wee put in at Dartmouth, the Wind South South West, verie fowle. And you may make a Kalender after such like order as this.

Month.

heare though I haue set but some dayes of the month: yet I meane you should set downe each day, and in the last space to note each dayes variation, and which Pole is elivated in the end, say: This 31. of July, sayling on an east winde by Gods protection, we had sight of *Madalena*, and at noone our latitude found by the Sunne pearing thorow the Vane of your Instrument 15. *de.* 3. *mi.* and by the North Starre the next morning the like: so at noone the South East part of *Madalena* South, and the Meridian distance from the Lizard 1009 leagues, and diference of longitude 57. *de.* and dominico South end 58. *de.* and in your way note thus, for example in a booke by it selfe: May the 24. from the 27. at noone, from South to East 10. *de.* 17. *mi.* latitude 23. *de.* 18. *mi.* ⊙. magnitude, Azimuth 130. *de.* 5. *mi.* True Azimuth 117. *de.* 12. *mi.* the variation 12. *de.* 53. *mi.* as in chap. 4. and set downe whatsoeuer is remarkable in your way, as well in the Sea as else for example being in the Latitude of 46. S. the body of the Iles of *Babe* North East, 7. leagues being to the North of the Maine shole that lyeth in mid way betweene *Mintain* and Iles *Babe* the West Land of *Babe* Iles North West ½. North 5. leagues from the South Ile of *Babe* towards the East by North. 20. leagues in Latitude 20. is a dry shole that hath to the W. N. W. of it a shole or Ledge that is 3. leagues off. Also from the dry shole is on to the N. E. and from the dry shole another to the E. S. E. from the dry shole the pike of *Pasamond* Hill 31. *de.* Mag. E. to N. 42. miles, which I found by obseruation: for being 6. miles from shole, my Angle of shole and Hill 85. *de.* and the Angle from shole to hill and Ship 87 *de.* from Hill to Shole and Ship 8. *de.* by which the distance was found, and the Hill appeared thus.

And for the soundings doe thus, Aprill 29. euening *Bantam* hill 17. *de.* 2. *mi.* from S. to W. 14. fatham *Polambain* and neare point 26. from S. to W. 14. fatham, at the same time A. N.E. by E. 3. leagues. 4. fatham.

And now lest any should say I haue prescribed many things to others, and can doe nothing my selfe; I will make an euident and plaine demonstration of most of these things, wherein I shall make mote cuse the booke of M. *Thom. Addison*, sometime of *Ratcliffe*, in his life time a good Sea man, and Mr. of the Ship called the

Palsgraue, bound to the East-Indies in the yeere 1624. where he dyed before he had diuulged them: his widdow not knowing what to doe in the matter, and I hearing of the same, did purchase the said bookes at my owne charge: Thinking it but my duty to quicken and raise vnto life for the benifit of my Country-men, according to the minde and intent of the Author, that which would haue dyed, or at lest was like to haue dyed in the shell.

First, therefore as I haue spoken of the cirkles of the materiall Speare and Globe, so I would haue you vnderstand them, though they be described in plano after this manner. This discription is common: but I haue described the parralell lines with prickes, the horison and cirkle of depression with blacke, the almacanter with the other parralells are red, the figments within are to shew the houre lines as that which croseth the equator as it were at right Angles: that which croseth the horizon: likewise to shew the Azimuth and that which croseth the Ecliptike to shew the Longitude and Latitude in the Heauens, and though thers 3. inscribed figments be somthing hard to doe by Geometricall demonstration, and for so much as they are of singular vse: Therefore when thou wilt finde the true Azimuth, Longitude, or houre on a parralell; Take thy Sector (see chap. 6.) and open it to the distance of the Semidiameter of that parralell in the totall Sine, then take the distance in the line giuen, and apply it in the paralell from the center it sheweth the true place.

Now I haue giuen a rule before for finding the Sunnes place in the Zodiack, see chap. 4. which we will for examples sake suppose to be the 30. day Aprill 1629. which is by the Tables of Origanus 19 *de.* 21 *m.* 2 *se.* of ♉, and by my rule iust 19 *de.* the point in this demonstration for that place is at B. and this point is found by the cirkle deuided as is before spoken of, chap. 4. by taking frommward the poles of the Zodiack, the Sunnes Longitude in degrees, which in this example is 49. *de.* hauing the day of the month, and the ☉. place found, the rest followeth most easily: For a parralell drawne to the equator thorow the point at B. sheweth the declination at C. from A. right Ascencion B.C. Amplitude A.D. Meridian height F.H. the difference Ascensionall C.D. and all the rest followeth, and are measured by degrees on the limbe. By the same I may say if

if the declination be giuen, as from A. to the Center, to C. the Æ parralell, which by Origanus for the 30. day of Aprill 1629. is 17. *de.* 40. *mi.* and by this it is 17. *de.* 30. which is but little lesse: and that was by the neglect of the minuts in the Sunnes Longitude. I will giue one demonstration more, and that shall suffise for this paper, for my purpose is to include all this worke within these few sheets.

This proiection is of that chapter the 4. May the 4. 1629. ☉ place the 23. *d.* 12. *m.* 41. *se.* ♉. Origanus Tables, declination 15. *d.* 32. *mi.* N. ☉ Longi. 53. *de.* 12. *mi.* 41. *se.* but by this proiection, Sunne place 23. *de.* and A. C. declination 18. *de.* 30. *mi.* Longitude 53. *de.* and at 8. from A. A. D. the Amplitude 28. *de.* E. F. the Meridian height 55. *de.* B. C. right Ascencion 30. *de.* C. D. difference Ascencionall 23. *de.* 0. *mi.* B. G. Obligue Ascencion 27 *de.* 0. *mi.* D. E. semydiurnall arke 7. *ho.* 32. *mi.* D. E. semynocturnall arke 4. *ho.* 28. D. H. length of twilight 2. *ho.* 4. *mi.* H. E. time from noone to euening shut is 9. *ho.* 33. *mi.* that double is the length of the day. 19. *ho.* 6. *mi.* This last taken from 24. leaueth the length of the night darke 4. *ho.* 54. *mi.* Sun riseth at D. 4. *ho.* 28. *mi.* seteth at 7. *ho.* 32. *mi.* Time from rising to setting 15. *ho.* 4. from Sun setting, to his rising 8. *ho.* 56. *mi.* Height of the Pole N. R. 51. *de.* 30. *mi.* Though many more propositions may be wrought by this kinde of proiection, yet to make some good vse of this marke, the last which is the height of the Pole found, so that if ye doe but remember the day of the month; which you must needs doe by your Kalender in the beginning of this chap. or his declination: take his amplitude Azimuth, or Meridionall height, hauing with you your Compasses: Compasse, crostafe, Sea-quadrant, Card, and some good Tables of the fixed Starres, that yee may vse them for obseruation in the night: and by all meanes I would haue you get the reconing of your Ships way by that excellent way of Mr. *Addisons* of the ½. minut glasse, the Log-line, and also by what true way soeuer the experienced Sea-man can bring to light; and then may you cast vp your Trauerse by that excellent way of the Arithmeticall Nauigation, by your Card and Trauerse bord, and by this Kalender, whose vse is this; Iune the 23. being in Latitude 48. *de.* 14. found by obseruation, wasfaled vntill the 24. noone that is

24. *ho.*

24. *ho.* there is the month, day, houre, in the 3 first columes vpon a course of 33. *de.* from S. to W. 20. leagues, the winde being N. N. E. all this is in the 3. next columes: the Latitude then obserued to be 47. *de.* 25. *mi.* Longitude in miles 88. from Lizard west and the variation 12. *de.* 53. *mi.* depth 90. fatham, (if it were found so) and these in the 3. last columes, and from Iuly the 19 in Latitude 17. *de.* 40. *mi.* to Iuly the 21. noone, that is 48. *ho.* we sayled on a course of 18. *de.* from W. to S. 74. leagues. The winde being at E. N E. which brought vs into the Latitude of 16. *de.* 35. *mi.* and into Longitude 1834. miles: or 611½. leagues W. from Lizard vnd 10. *de.* 0. *mi.* Depths 60. fatham, S. W. 7. leagues a Rock, & S. by W. land thus. Note that if you get your height and course exactly, it will correct your way, height and way will correct your course: course and way will correct your height: but striue to doe all as exact as posible you can, to doe which, note what followeth.

Propositions of Nauigation, Arethmetically, Geometrically, and Instrumentally shewed.
Chap. 8.

1. *To finde the leagues run on any course, the difference of Latitude and course being given.*

1 As the sine of the course from the parralell is to the miles in difference of Latitude: so is the totall sine to the leagues run.

2 As the Tangent of the course, from the parralell is to the miles in a degree of Latitude; so is the Secant of the course to the way.

3 As the totall sine is to the miles in the difference of Latitude; so is the Secant of the course, from the Meridian to the miles run.

4 As the sine of the course from the Meridian is to the miles in difference of Latitude; so is the Tangent of the course from Meridian to the way.

5 Let the Logarithme of the course from the parralell be taken out of the Logarithme of miles in difference of Latitude, the remainder is the Logarithme of the miles in way.

6 Instrumentally by the Sector, take in the equall parts the miles

is difference of Latitude and fit it ouer in the equall lines of the course from the parralell, the Sector so opened, take the distance ouer in the totall signe and that distance applyed to the equall parts giueth the miles of way run.

2 *The difference of Latitude and Longitude giuen to finde the leagues run.*

SQuare both sides, then ad the 2. squares together and extract the square roote is the miles in way run. 1

Looke which is the greater side, either the Lat. or the Lon. and take his Log. out of the Log. of the lesser side, the remainder giueth the two acute Angles, then let the Log. of either of them be taken out of the Log of the side opposit, the remainder is the Log. of way. I shew not how it giueth the Angles but leaue thee to inquire. 2 This also giueth the Rombe.

Open the Sector to a rectangle: then take the miles in Longitude and set it on one side, the Sector from the Centor in equall parts, and the miles in Latitude on the other side: then take the distance ouer with a paire of Compasses, and apply that distance to the equall parts, giueth the number of miles in way. 3

3 *To finde the difference of Longitude, the course and difference of Latitude being giuen.*

AS the sine of the course from the parralell is to the difference in Latitude, so is the sine of the course from the Meridian to the difference in Longitude. 1

As the totall sine is to the difference in Latitude: so is the Tangent of the course from the Meridean to the Longitude. 2

As the Tangent of the course, from the parralell to the miles in Latitude: so is the totall sine to the miles in Longitude. 3

As the Secant of the course from the parralell is to the difference of Latitude: so is the Secant of the course from the Meridian to the Longitude sought. 4

Take the Logarithme difference of the Angle from the Meridian out of the Logaritme of the difference of Latitude in miles the remainder is the logaritme of Longitude in miles. 5

Take the number of equall parts (in the Sector) which are the difference of Latitude, & fit that distance ouer in the lines of sines 6

of course from the parrall, and the instrument opened to that wideneſſe: the diſtance ouer in the fine of the courſe from the Meridian: that diſtance applyed to the equall parts, ſheweth the Longitude in miles.

4 *To finde how many miles off the equator or Meridian is a degree of Longitude in any parralell of Latitude.*

As the totall ſine is to the miles in a degree of the equator: ſo is the ſine of the complement of Latitude to the miles ſought.

As the Tangent of the Latitude is to a degree in the Meridian: ſo is the ſine of the Latitude to the miles ſought.

As the Secant of the Latitude is to the miles in the equator or Meridian: ſo is the totall ſine to the miles ſought.

As the Secant of the complement of Latitude is to the miles of Meridian: ſo is the Tangent of the complement of Latitude to the miles, anſwering a degree.

Let the logarithme of the complement of Latitude be added to the logarithme of miles in a meridians degree; the totall is the logarithme of miles ſought.

Inſtrumentally, take the number of equall parts in a degree of the Meridian or equator by the Sector, & fit them ouer in the ſines totall: then take the diſtance ouer in the ſines of the complements of Latitude, and apply that to the equall parts, ſheweth the miles that make a degree of Longitude in that parralell.

5 *To finde the Longitude anſwering to a Meridian diſtance in any parralell of Latitude.*

As the ſine of the complement of Latitude is to the Meridian diſtance: ſo is the totall ſine to the Longitude.

As the ſine of the Latitude is to the Meridian diſtance: ſo is the Tangent of the Latitude to the Longitude.

As the totall ſine to the Meridian diſtance: ſo is the Secant of Latitude to the Longitude.

As the Tangent of the complement to the Meridian distance: so is the Secant of the complement to the Longitude. 4

Let the Logarithme of the complement be taken out of the Logarithme of Meridian distance, then remainder is Logarithme of Longitude. 5

Take from the scale of equall parts in the Sector the Meridian distance; and fit with your Compasses in the sines of the Latitudes complement: then the distance taken betweene 90. and 90. applyed to the same scale, giueth the Longitude.

6 To finde the signe of any Arke in a parralell.

AS the totall sine is to the complement: so is the sine giuen in the great Cirkle to the sine in the Latitude. 1

As the Tangent of Latitude to the sine of Latitude: so is the sine of the Arke in the great Diameter to the sine of the Arke in the lesser. 2

As the Secant of Latitude to the totall sine: so is the sine in the greater, to the sine in the lesser Semydiametor. 3

As the Secant of the complement is to the Tangent thereof: so is the sine in the greater to the sine in the lesser. 4

This reduceth Longitud miles into degr:

Add to the Logarithme of the Arke giuen, the Logarithme of the complement of Latitude, the totall is the Logarithme of sine demanded. 5

By the Sector let the distance from the Centor to the Arke giuen be put over in 90. and 90. then the distance betweene the sines of the complement of Latitude, applyed from the Centor, giueth the Arke whose sine is the demanded. 6

7 By a sine giuen in a parralell, to finde the Arke.

AS the sine of the complement of the Latitude is to the sine giuen: so is the totall sine to the sine of the Arke. 1

As the sine of the parralell is to the sine giuen: so is the Tangent of the parralell to the sine of the Arke sought. 2

As the totall sine is to the sine giuen: so is the Secant of parralell to the sine of the Arke sought. 3

As the Tangent of the complement is to the sine giuen: so is the Tangent thereof to the sine of the Arke sought. 4

1 One of the Logarithme of the fine given, take the Logarithme of the complement of Latitude the reſt is the Logarithme of the fine.

6 By Inſtrument let the diſtance of the ſigne giuen be taken from the Centor and fitted in the fine of the complement of Latitude; then the diſtance betweene 90. and 90. being ſet from the Centor ſheweth the Arke.

It reduceth Meridian degrees in to Longitude.

8 *To finde how many miles on Earth or Sea ſerueth to a minute of time in the Heauen, in any parralell of Latitude.*

1 AS the totall fine is to 15. mile, which ſerueth a minute of time vnder the equator: ſo is the fine of the complement of Latitude to the number ſought.

2 As the Tangent of the Latitude is to the miles in the equator: ſo is the fine of the Latitude to the miles ſought.

3 As the Secant of the Latitude is, to the miles in a minute at the equator: ſo is the totall fine to the miles in a minute of that parralell.

4 As the Secant of the complement of Latitude, is to the miles in the equator: ſo is the Tangent thereof to the miles in a minute of that parralell.

5 Add the Logarithme of the 15. miles, to the Logarithme of the complement of Latitude, the ſumme is the Logarithme of the miles in that parralell.

6 By the Inſtrument or Sector, take 15. the miles that ſerue in the equator to a minute of time out of the equall parts, and fit it ouer in the totall fines: then the diſtance ouer in the fine of the complement of Latitude applied to the equall parts, ſheweth the miles to a minute in that parralell.

1 This chapter hath ſhewed how to finde the leagues run on any courſe, or the Ships way, and to finde the difference of Longitude, with things thereto pertaining, the next ſheweth.

Chapter the 9.

2 *To finde the courſe the way and difference of Latitude giuen.*

AS the miles in way (or run) is to the totall fine: ſo is the miles in difference of Latitude to the courſe (or run) his fine from parralell

As the miles in difference of latitude to the totall sine, so the miles in way to the secant of course from meridian. 2

As the difference of latitude to the way, so the totall sine to the secant of course from meridian. 3.

Square both difference of latitude and way, then subtract the lesser out of the greater, out of the remainder, extract the square roote, then as that roote to the totall sine, so the difference of latitude to tangent of course from paralell. 4 This gives the longitude.

Let the logarithme of way be taken out of the logarithme of difference of latitude, the remainder is logarithme of course from paralell. 5

Take the equall parts in way, and fit over in the totall sine, then take the difference of latitude, and fit over in equall sines, giues the course from paralell. 6.

10. *To find the course, the way, and longitude given.*

AS the way to the totall sine, so the longitude to course from the meridian. 1

As the longitude to the totall sine, so the way to the secant of course from paralell. 2

As the longitude to the way, so the totall sine to the secant of course from paralell. 3

Square both longitude and way, then subtract the lesser out of the greater, out of the remainder extract the square roote, then as that roote to the totall sine, so the longitude to the tangent of course from the meridian. 4. This gives the latitude,

Let the logarithme of way be taken out of the logarithme of difference of longitude, the remainder is logarithme of course from the meridian. 5

Let the equall parts in way be fitted over in the totall sine, then the long. fitted over in equall sines, gives the course from the meridian. 6

11. *To find the course, the longitude and latitude given.*

AS the ½ of the 2 sides added, is to the difference of each side, so the tangent of ½ the 2 unknowne angles, to the tangent of an arke, which being added to, or taken from ½ the 2 vnknowne angles, gives the course. 1

Take the logarithme of the greater side, out of the loga- 2

 rithme

rithme of the leſſer, the remainder is logarithme of the angle oppoſite to the leſſer ſide.

Open the ſector to a rectangle, and take the longitude and latitude, and fit them on 2 ſides from the center; and from thoſe 2 extenſions take the diſtance with a paire of compaſſes, and fit it over in the totall ſine; Then take the longitude, and fit over in equall ſines, gives the courſe from the meridian, but the latitude ſo fitted gines the courſe from paralell.

12. *To find the latitude, the courſe and way giuen.*

1 AS the totall ſine to the way, ſo the ſine of courſe from paralell to the latitude ſought.

2 As the ſecant of courſe from paralell to the way, ſo the tangent of the ſame to the difference of latitude.

3 As the ſecant of courſe from the meridian, to the way, ſo the totall ſine to the difference of latitude.

4. As the tangent of courſe from the meridian, to the way, ſo the ſine of the ſame courſe to the difference of latitude.

5 Adde the logarithme of way to the logarithme of courſe from paralell, the totall is the logarithme of difference of latitude.

6. Take the miles in way, and fit over in the totall ſine, then the diſtance over in the ſine of courſe from paralell, gives the miles in difference of latitude.

I haue ſhewed already, chap. 7. how the diſtance from Paſamont hill was found; And as I conceiue, it is eaſie to finde the diſtance of places, if you doe but know the vſe of my Table of ſines, tangents and ſecants, proviſo, note that the 3 angles of any right-lined triangle is equall to 2 rectangles or 180 degrees.

For commonly at ſea, you muſt obſerue the land, ſhore, or whatſoever it is you would know the diſtance from, what angle it maketh with your courſe; as admit 40 degrees, then reckon your ſhips way, ſuppoſe 1000 fathome, and then obſerve againe, let your ſecond angle be 100 degrees, then adde 100 degr: & 40 degr: which ſubtract from 180 degr: remainder 40 degr: for the third angle; then haue you 3 angles and one ſide given, by which meanes the other 2 ſides are eaſily had, and conſequently the diſtance. Now

Now if the young beginner be troubled to finde the fine of an angle, ſo big as 100 degr: let him note what the Table ſaith; ſubtract 90 degr: from 100 degr: the remainder 10 degr: ſubtract from 90 degr: reſts 80 degr: or ſubtract 100 degr: from 180 degr: reſts 80 degr: whoſe fine in my table is 985; the other two angles being 40 degr: and 40 degr: their fines are 643 and 643, and the diſtance 1000 fathome: Now to fetch the diſtance from ſhore ſay, as 643 the fine of 40 degr: at *c*, found as before, to 1000 fathome, the diſtance from *a* to *b*, the 2 places of obſervation, ſo 984 the fine of 80 degr: in the leſſer quadrant, or 100 degr: in the great, (which is all one) to the diſtance from *a* to *c* 1531 $\frac{101}{211}$ fathome. Another example. 996 fine of 84 degr: 50. 985 fine of 80 de. 262 fine of 15 d: 10. Let your firſt obſervation be at *b* 80 degr: the ſecond at *d* 84 degr: 50, and by your reckoning the diſtance 254 fathome; now it is eaſy by the former rule to find the angle at *c* 15 degr: 10: then ſay if 262 gine 254, what gines 985, facit *c d* 954 $\frac{110}{111}$: And as 262 to 254, ſo 996 to the diſtance *b c*. So that it is all one whether the angles be right, or obtuce, or acute, if they be all acute, there is no more to doe but take the fines out of my table as in the figure K, and no more, if one be a rectangle, then the other 2 are acute, but if an angle be obtuce, as in the figure L, the angle at *b* 100 degr: doe by that angle whatſoever it be, as in the firſt example; here becauſe the angles at *a* and *c* are equall, therefore the diſtance from *b* to *c* is 1000 fathome.

But by the ſecond example, it is but 965 $\frac{77}{111}$, therefore the angle at *d* was not truly taken; for what 965 $\frac{77}{111}$ is in proportion to 1000, ſo is the angle at *d* to the true angle: which muſt needs be more then 84 degr: 50, and the angle at *c* leſſe then 15 degr: 10 and conſequently the ſide *c d* is more then 954 $\frac{110}{111}$. And further you may note, if you have obſerved ſo well that the angles be truly taken, then have you not reckoned your ſhips way truly; and ſo you may ſee that one of theſe doth correct the other, as in the end of the 7 chapter.

And you may fetch a diſtance by Geometricall protraction, as in chap. 4. ſuppoſe you would know the diſtance from *c*

and *b* to *f*, in the figure *m*, first having drawne the angle *b e f*, then reckon your ships way from *e* to *b* 300 fathome, and having laid downe so much by your scale and compasses, (see pag. 12) you shall observe to lay the line *e b* right in the course your ship went, with *b* next your eye, and *e* towards the place of your first observation; then from *b* draw another line to *f*, and that line will intersect with the line *a f* at *f*, and then you may measure the distance; as in this example *b f* is 100 fathom, and *e f* is 140 fathom.

The next thing that will trouble the young beginner, is the propositions in these 8 and 9 chapters, which are most easily performed, because the demonstration is so plaine.

First therfore as in all plain triangles, the sides are in proportion one to another, as the subtences of the angles opposite, or as the sines of the angles opposite to those sides. Example in the inscribed triangle: *e f* the angle at *b* is in proportion to the side *c d* or arke *c g d*, as the angle *c* to the side *b d*, or arke *b d e*, and so is the angle *d* to the side *b c*, or arke *b f c*.

So note that in all rectangled right-lined triangles, the two containing sides of the rectangle stand perpendicular one upon the end of another: Therefore if you put the least side for radius or totall sine, as in the figure *b*, the other side will be the tangent, and the subtending side of the rectangle will be the secant; or if you put the greater side for radius, the least will be the tangent, and the subtence the secant, or you may put the subtence for radius, as in the figure *c* is done.

It is manifest then that any side may be put for the totall sine: First, if you put the subtending side for radius, as in the figure *d*, let *a b* be part of a meridian, and *a c* part of a paralell; then is the angle at *b* the course from the meridian, and the angle at *c* is the course from paralell.

Then if the difference of latitude *a b*, and course, that is the angle at *b* or *c* be given, you may finde the leagues runne, or distance *b c*, as in the first resolution Arithmeticall.

Or if you put the longer side *a b* for radius, then say as the totall sine *a b* to the difference of latitude *a b*, so the secant *b c* of course, *b* from the meridian, to the distance *b c*; if you put the

the leaſt ſide for radius, ſay as the tangent *a b* of courſe *c* from parallell, to *a b* the difference of latitude, ſo *b c* the ſecant of the ſame courſe, to *b c* the diſtance. Let this ſuffice for the firſt propoſition chap. 8.

But if you demaund the difference of longitude, the latitude and courſe being given, you may doe it by the firſt or ſecond example Arithmeticall in this chapter, page 29; or if you put the longer ſide *b c* for radius, ſay, as the courſe *c* to *a b*, ſo the courſe *b* to *a c* the longitude: but if you put the ſide *a b* for radius, ſay, as the totall ſine to the difference of latitude, ſo the tangent *a c* to the difference of longitude: if the leaſt ſide be put for radius, ſay, as the tangent *a b* to the difference of latitude, ſo the totall ſine to the difference of longitude. And this ſufficeth for the Geometricall demonſtration of the third propoſition, chap. 8.

And now you ſee how the proportionall numbers doe ariſe, it is eaſie to take them out of the Table, and worke them Arithmetically; and what is ſaid of theſe propoſitions may be ſaid of all the reſt by the very ſame reaſon; except the ſecond propoſition chap. 8, and the 11 propoſition in this chapter page 27: the firſt of theſe is done as in *Euclid* 1.47, or thus Arithmetically.

Let the line *a* be 3 leagues of longitude, and the line *b* 4 leagues of latitude, firſt multiply 3 into 3, it is 9, and 4 into 4 is 16, which added is 25, the ſquare roote is 5, for 5 times 5 is 25, and this is equall to the line *c*, the ſhippes way.

The Geometricall demonſtration is this, let the line *a* perpendicular vpon the line *b*, as in the figure *f*, then draw the line *c*, and it is 5 the ſhippes way.

There is another way of demonſtration, by adding the ſides of the ſquares into one; alſo if the way and longitude had beene given, to ſubtract the one out of the other Geometrically, the remainder is the difference of latitude: if the way and latitude had beene given, then the ſide of the remainder is the difference of longitude, *Euclid* 1.47. *theor.* 33. & 31. *theor.* 21.

The next ſhould be of the 11 propoſition, but I ſuppoſe he

and *b* to *f*, in the figure *m*, first having drawne the angle *b e f*, then reckon your ships way from *e* to *b* 300 fathome, and having laid downe so much by your scale and compasses, (see pag. 12) you shall observe to lay the line *e b* right in the course your ship went, with *b* next your eye, and *e* towards the place of your first observation; then from *b* draw another line to *f*, and that line will intersect with the line *a f* at *f*, and then you may measure the distance; as in this example *b f* is 100 fathom, and *e f* is 140 fathom.

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The next ſhould be of the 11 propoſition, but I ſuppoſe he

that understands that is more than an ignorant man, therefore whosoever will learne that, with the extraction of the square and cube roote, or any thinge else that is in my booke, or any of those things that I have set out in any of my bills; let them come to my dwelling, and I will satisfie their demaund so farre forth as God shall inable mee: where youth may bee taught, dieted and lodged for reasonable consideration.

Chap. X.

Of the motion of the Moone, and comming into the Harbour.

I Might here have added many and manifold propositions, and chiefly those which doe concerne the great circle distance betweene any two places howsoever scituate; but I will first see thy kinde acceptance of this: which if you receive thankfully, I shall be ready to shew thee many more to thy great satisfaction, with the Geometricall demonstration, which I have gathered into a booke in Folio.

And now I will finish this worke with the Moones motion; supposing you are come in sight of your wished port in safety: which I doe heartily wish to all honest Seamen of my Country, that travell the seas to good ends.

And admit you are in a strange coast, you may the better come to finde the time of a full sea, at a spring tide, to bring your good shippe over a barre or shole: so I shall end my worke where Mr. *Addyson* began his: then having read this, you may reade his which is hereto joyned; giving you to understand, if you learne well these propositions of mine, they will make even the hardest things in his booke easy for thy understanding.

Let

Let the full ſea at your place of being be at 2 ☽ Moone on the day of conjunction as at *a*, and the Sunne going in 4 degrees, as from *a* to *c*, the Moone removing in the meane time 48 degrees from the Sunne, as to *d*, doth make 3 houres 12 minutes after noone for the time of high water; and in 16 dayes more the Sunne going from *c* to *e*, that is 60 degrees from *a*: in the meane time the Moone going from *d* to *f*, that is 360 degrees from *a*, which maketh 17 houres 20 minutes, then ſubſtract 12 houres 0 minutes from 17 houres 20 minutes, the remainder 5 houres 20 minnes; out of which take 1 houre 20 minutes for the time of the Sunnes motion in 20 dayes, remainder 4 a clocke for the true time of full ſea the Moone being 20 dayes olde; if you perceive not the reaſon hereof inquire further, and ſo you may examine the truth hereof.

Therefore to the ignorant and honeſt Seaman I ſay, joyne theſe things in practiſe with thoſe things thy Maſter doth teach thee at ſea: And to thoſe things you learne at ſea by experience joyne the practiſe of the things taught in this booke, and you ſhall be able in ſhort time, through Gods grace, no doubt, to take charge thy ſelfe to thy great commendations.

To conclude, you may doe moſt of the things taught in this booke as afore ſpoken of chapter the 4, with ruler and compaſſes; which if you practiſe and make your ſelfe able to performe, (wiſhing to every good man that is willing to follow theſe rules, that I were at his elbow to make him a more plaine demonſtration) he ſhall be able in a ſhort time, to doe ſuch ſervice, which without theſe will not be performed in ten times ſo much time.

And ſo I pray thee to accept of this my labour, for unto ſuch as are ignorant and honeſt, that would learne, onely doe I write this booke. And be ſure to reade it all before you judge, ſo ſhall you ſee that ſuch a thing there is, then reade it over againe, and you ſhall ſee what manner of thing it is, ſo you may judge of the good will of the Authour, and reade it over the third time to thy ſingular profit.

As in *Ecclesiasticus* chapter the 22. verse 23. *Admonish thy neighbour, so I say to thee of thy friend in Navigation; Be faithfull to him in his poverty, that you may rejoyce with him in his prosperity, abide stedfast with him in the time of his trouble, that you may be heire with him in (this his little booke) his heritage: for a meane estate is not alwayes to be contemned, nor the rich that is foolish to be had in admiration.*

Now I beseech Almighty God of his mercy in Christ Iesus, that we may so profit in Christs schoole, that we may bee able thereby to passe the waves of this sea of glasse, that we may all arrive at the haven of eternall happinesse, Amen.

FINIS.

BIBLIOTHECA LAMBETHANA

Fachiro

Each 10. minuts of every degree of the same Quadr

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20	6	23	41	58	76	93	111	129	20	146	164	182	2
	1000	1000	1001	1002	1003	1004	1006	1008		1011	1013	1017	10
	9	26	44	61	78	96	113	131		148	165	182	1
30	9	26	44	61	79	96	114	132	30	149	167	185	2
	1000	1000	1001	1002	1003	1005	1006	1009		1011	1014	1017	10
	12	29	47	64	81	99	116	133		151	168	185	2
40	12	29	47	64	82	99	117	135	40	152	170	188	2
	1000	1000	1001	1002	1003	1005	1007	1009		1012	1014	1018	10
	15	32	49	67	84	102	119	136		154	171	188	2
50	15	32	49	67	85	102	120	138	50	155	173	191	2
	1000	1001	1001	1002	1004	1005	1007	1009		1012	1015	1018	10

mi.	24	25	26	27	28	29	30	31	mi.	32	33	34	35
	407	423	438	454	469	485	500	516		530	545	559	
0	445	466	488	510	532	555	577	601	0	625	649	675	
	1095	1103	1113	1122	1133	[illegible]	1155	1167		1179	1192	1206	12
	409	425	441	457	472	[illegible]	503	518		532	547	562	5
10	449	470	491	513	535	558	581	605	10	629	654	679	7
	1096	1105	1114	1124	1134	1145	1157	1169		1181	1195	1209	12
	413	428	444	459	475	490	505	520		535	550	564	5
20	452	474	495	517	539	562	585	609	20	633	658	683	7
	1097	1106	1116	1126	1136	1147	1159	1171		1284	1197	1211	12
	415	431	446	462	477	492	508	522		537	552	566	5
30	456	477	499	521	443	566	589	613	30	537	662	687	7
	1099	1108	1117	1127	1138	1149	1161	1173		1186	1199	1213	12
	417	433	449	464	480	495	510	525		540	554	569	5
40	459	481	502	524	547	570	593	617	40	641	666	692	7
	1100	1109	1119	1129	1140	1151	1163	1175		1188	1202	1216	12
	420	436	451	467	482	497	513	527		542	557	571	5
50	463	484	506	528	551	573	597	621	50	645	670	696	7
	1102	1111	1121	1131	1142	1153	1165	1177		1190	1204	1218	12

mi.	48	49	50	51	52	53	54	55	mi.	56	57	58	59
	743	755	766	777	788	799	809	819		829	839	848	
0	1111	1150	1192	1235	1280	1327	1376	1428	0	1483	1540	1600	16
	1494	1524	1556	1689	1624	1662	1701	1743		1788	1836	1887	1
	745	757	868	779	790	800	811	821		831	840	850	
10	1117	1157	1199	1242	1288	1335	1385	1437	10	1492	1550	1611	1
	1500	1529	1561	1595	1630	1668	1708	1751		1796	1844	1896	1
	747	759	770	781	792	803	812	822		832	842	851	
20	1124	1164	1206	1250	1295	1343	1393	1446	20	1501	1560	1621	1
	1504	1535	1567	1601	1636	1675	1715	1758		1804	1853	1905	1
	749	760	772	783	793	804	814	824		834	843	853	
30	1130	1171	1213	1257	1303	1351	1402	1455	30	1511	1470	1632	1
	1509	1540	1572	1606	1642	1681	1722	1766		1812	1862	1914	1
	751	762	773	784	795	806	816	826		835	845	854	
40	1137	1178	1220	1265	1311	1360	1411	1464	40	1520	1580	1643	1
	1414	1545	1578	1612	1649	1688	1729	1773		1821	1870	1923	1
	753	764	775	786	797	807	817	827		837	847	856	
50	1144	1185	1228	1272	1319	1368	1419	1473	50	1530	1590	1653	1
	1519	1550	1583	1618	1655	1695	1736	1781		1828	1878	1932	1

mi.	72	73	74	75	76	77	78	79	mi.	80	81	82	
	951	956	961	066	970	974	978	982		985	988	990	
0	3078	3271	3487	3732	4011	4331	4705	5145	0	5671	6314	7115	8
	3236	3420	3628	3864	4134	4445	4810	5241		5759	6392	7185	
	952	957	962	967	971	975	979	982		985	988	991	
10	3108	3305	3526	3776	4061	4390	4773	5226	10	5769	6435	7260	
	3265	3453	3665	3906	4182	4502	4876	5320		5855	6512	7337	
	953	958	963	967	972	976	980	983		686	989	991	
20	3140	3340	3566	3821	4113	4449	4843	5309	20	5871	6561	7419	
	3295	3486	3703	3950	4232	4560	4945	5394		5955	6636	7486	
	954	959	964	968	972	976	980	984		986	989	991	
30	3172	3376	3606	3867	4165	4511	4915	5396	30	5976	6691	7596	
						4520	5016	5487		6059	6765	7661	
						977	981	984		987	989	992	
40					4574	4985	5485		40	6084	6827	7770	
					4682	5089	5575			6066	6900	7814	
					974	978	981	984		987	990	992	
50					4775	4638	5066	5576	50	6197	6968	7911	
					4390	4745	5164	5665		6277	7040	8018	

72	71	70	69	68	67	66	65	64	mi.	63	62	
946	940	934	927	921	914	906	899			891	883	875
2904	1747	1605	1475	1336	1246	1145	1050	o		1963	1881	1804
2074	1924	1790	1669	1559	1466	1366	1281			1302	1220	1063
946	941	935	928	922	915	908	900			892	884	876
1932	1773	1628	1496	1375	1264	1161	1066	10		1977	1894	1816
2098	1947	1812	1689	1577	1475	1381	1295			1221	1142	1074
947	942	936	929	923	916	909	901			894	886	877
2960	1798	1651	1517	1394	1282	1177	1081	20		1991	1907	1836
3124	1971	1833	1709	1595	1491	1396	1309			1228	1154	1085
948	943	938	930	924	917	910	903			895	887	878
2979	1924	1675	1539	1414	1300	1194	1097	30		2006	1921	1842
3152	1995	1855	1729	1613	1508	1411	1322			1241	1166	1096
949	944	938	931	926	918	911	904			896	888	880
3018	1850	1699	1560	1434	1318	1211	1112	40		2030	1935	1855
3172	2011	1879	1749	1632	1525	1427	1337			1254	1178	1107
950	945	939	933	926	920	913	906			898	890	882
3192	2046	1901	1769	1650	1542	1443	1352			1268	1190	1118
3207	2067	1919	1784	1663	1552	1451	1358	50		1273	1194	1120
951	946	940	933	927	920	913	906			898	890	882
3219	2082	1933	1796	1673	1561	1458	1364			1278	1198	1123
3228	2093	1944	1805	1681	1568	1464	1369	60		1281	1201	1125
952	946	940	933	927	920	913	906			898	890	882
3235	2101	1952	1812	1687	1574	1469	1374			1285	1204	1128
3240	2107	1957	1817	1692	1578	1473	1377	70		1287	1206	1130
952	946	940	933	927	920	913	906			898	890	882
3243	2110	1960	1820	1695	1581	1476	1380			1289	1208	1132
3245	2113	1962	1822	1697	1583	1478	1382	80		1290	1209	1133
952	946	940	933	927	920	913	906			898	890	882
3246	2114	1963	1824	1698	1585	1480	1384			1291	1210	1134
3247	2115	1964	1825	1699	1586	1481	1385	90		1292	1211	1135

90	89	88	87	mi.	86	85	84	
1000	999	999	999		998	998	996	995